High precision gyroscope module JY-61 Series

User Manual

1 Product Description

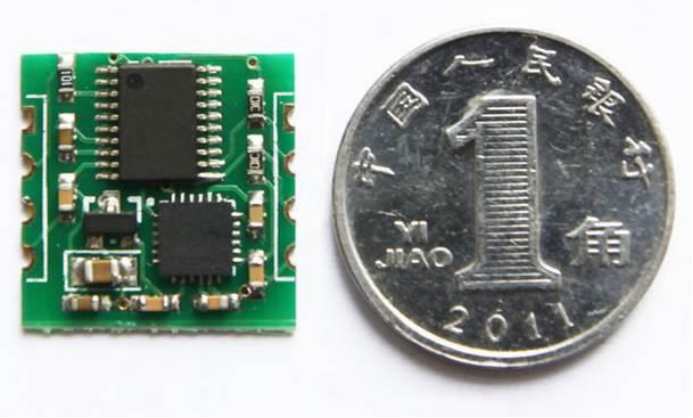
1) JY-61 series module integrates high-precision gyroscopes, accelerometers,, high-performance microprocessors and advanced dynamics solver and dynamic Kalman filter algorithm to quickly solve the current real-time movement of the module attitude .
2) The use of advanced digital filtering technology, can effectively reduce the measurement noise and improve measurement accuracy.
3) Integrates gesture solver, with dynamic Kalman filter algorithm, can get the accurate attitude in dynamic environment, attitude measurement precision is up to 0.01 degrees with high stability, performance is even better than some professional inclinometers!
4) Integrate voltage stabilization circuit, working voltage is 3v ~ 6v, pin level compatible 3.3V and 5V embedded system .
5) Supports serial port. Data output frequency 100Hz (baud rate 115200) / 20Hz (9600 baud).
6) Module retains MPU6050 I2C interface, in order to meet the needs of advanced users to get the original data of MPU6050
7) Stamp hole gold plating PCB design, can be embedded in the user's PCB board.
8) 2layer PCB technology, thinner, smaller, and more reliable.

Note: This module does not contain magnetometer, no filtering for the yaw angle, so yaw angle is calculated by integration, it will drift, the yaw angle is accurate only in a short time. The X, Y axis angle is accurate because it can be filtered by gravity field, it will not drift.

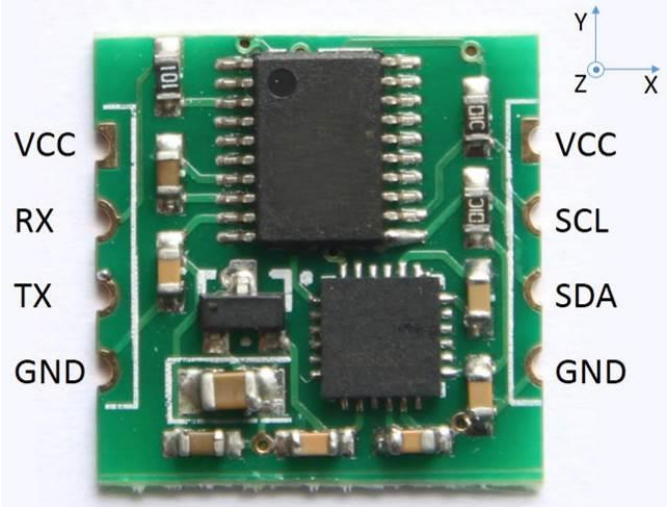
2 Technical Indicator

1) Input voltage: 3V-6V
2) Consumption current: <10mA
3) Volume: 15.24mm X 15.24mm X 2mm
4) Pad pitch: up and down 100mil (2.54mm), left and right 600mil (15.24mm)
5) Measuring dimensions: Acceleration: 3D Angular Velocity: 3D Attitude angle: 3D Magnetic field：3D
6) Range: Acceleration: ±16g, angular velocity: ±2000 °/ s.
7) Resolution: Acceleration: 6.1e-5g, Angular velocity: 7.6e-3 °/ s.
8) Stability: Acceleration: 0.01g, angular speed 0.05 °/ s.

9) Attitude stabilization measurement: 0.01 °.
10) Data output: time, acceleration, angular velocity, angle,
11) Data output frequency 100Hz (baud rate 115200) / 20Hz (9600 baud)
12) Provide single-chip analytical sample code.



3 Pin Description



Name	Function
VCC	Power，3.3V or 5V Input
RX	Serial data input ，TTL level
TX	Serial data output ，TTL level
GND	GND
SCL	I2C Clock line
SDA	I2C Data line

As shown in the figure above, the coordinates of the module are indicated, and the right is the X axis, the upper is Y axis, the Z axis is perpendicular to the surface of the paper to yourself. The direction of rotation is defined by the right hand rule, that is, the thumb of the right hand is pointed to the axial direction, and the four is the direction of the bending of the right hand.

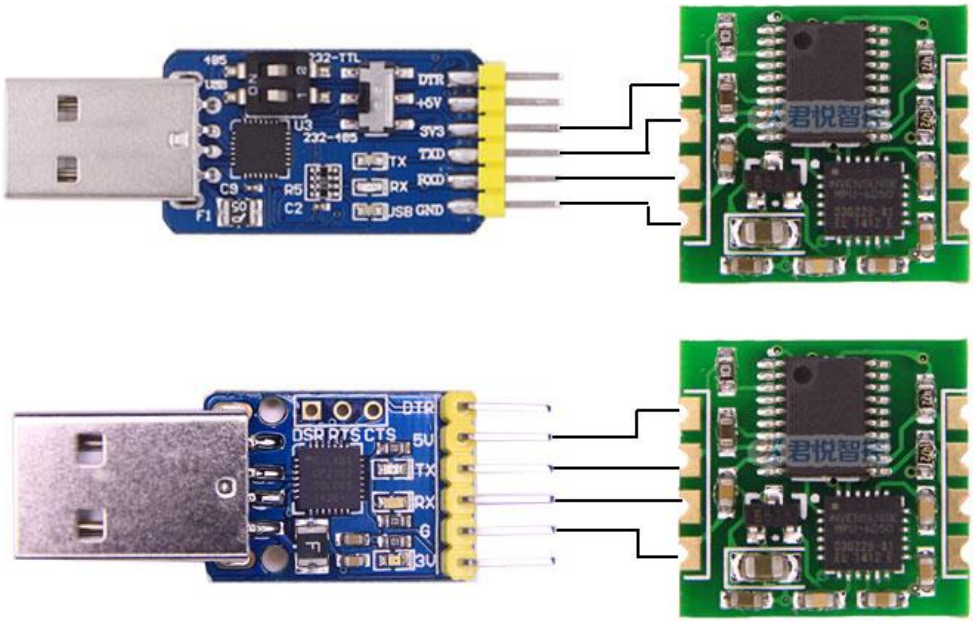
4 Hardware connection method

4.1 Connect to PC

USB to TTL tool connect to JY-61 module：USB to TTL tool:+5V，TXD，RXD，GND are

respectively connected JY-61 module :VCC，RX，TX，GND。Note TXD and RXD should be crossover。

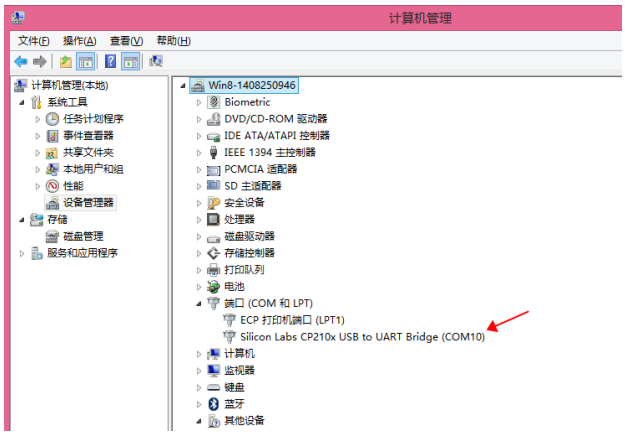
(Notice：The switch of Six serial interface module needs to be configed as the following figure when connecting to 6050 module)



4.2 Installation USB-TTL module driver

First, the module is connected via USB-TTL module to the computer, install the USB-TTL module driver.

After installing the USB-TTL module driver, and then Device Manager can query corresponding serial number, as below figure shows:



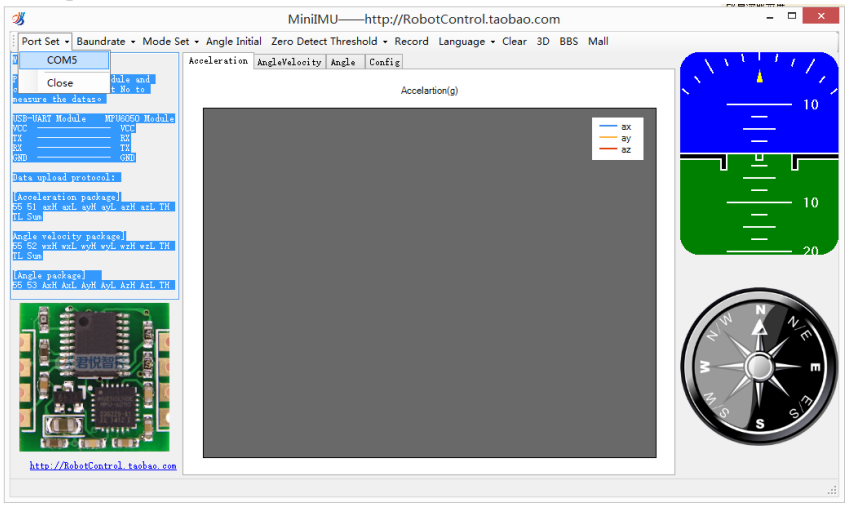
4.3 Open PC program of JY-61

Note that if the host computer is unable to run the user please download the install framework4.0.Net:

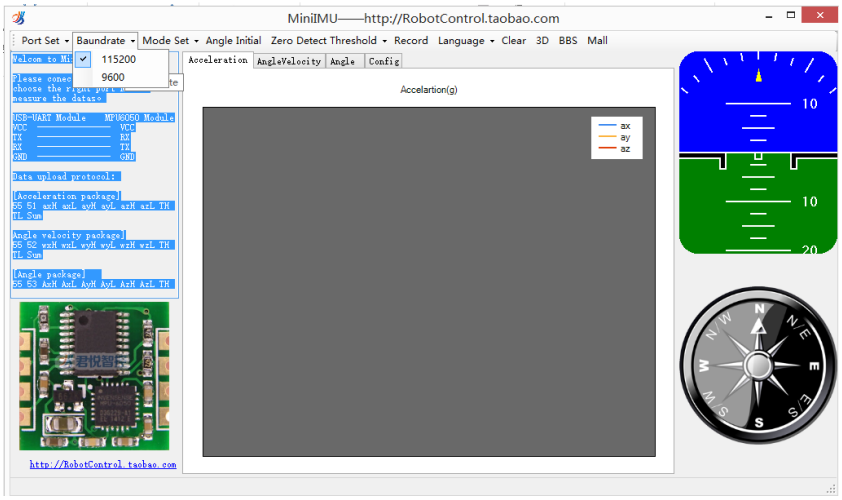
http://www.microsoft.com/zh-cn/download/details.aspx?id=17718

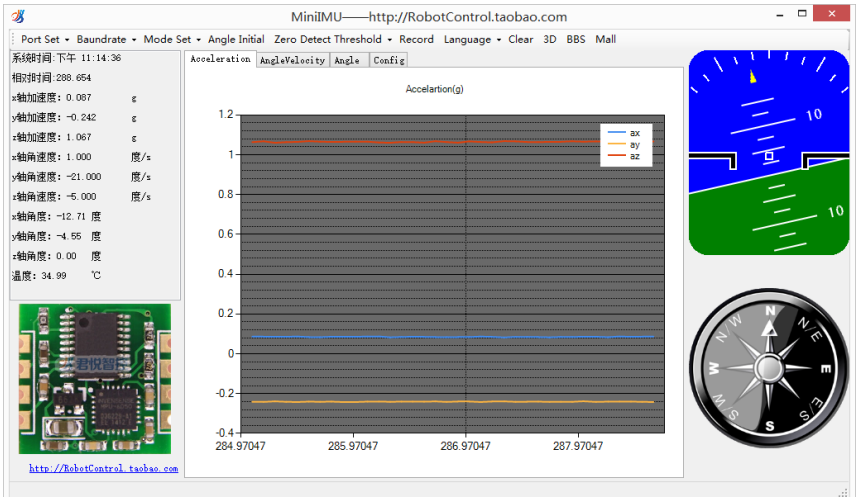
Open the PC software, first click on the baud rate menu, select the baud rate module, the default setting is 115200. Then click Serial port Settings menu, select the Port number the same as the USB-TTL module which query in 4.2. As shown below.

1、choose the port

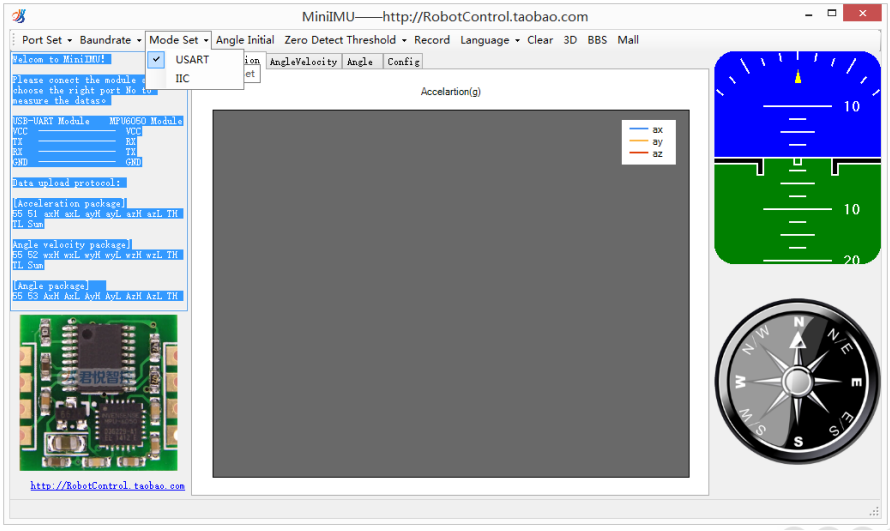


2、Choose the baud rate

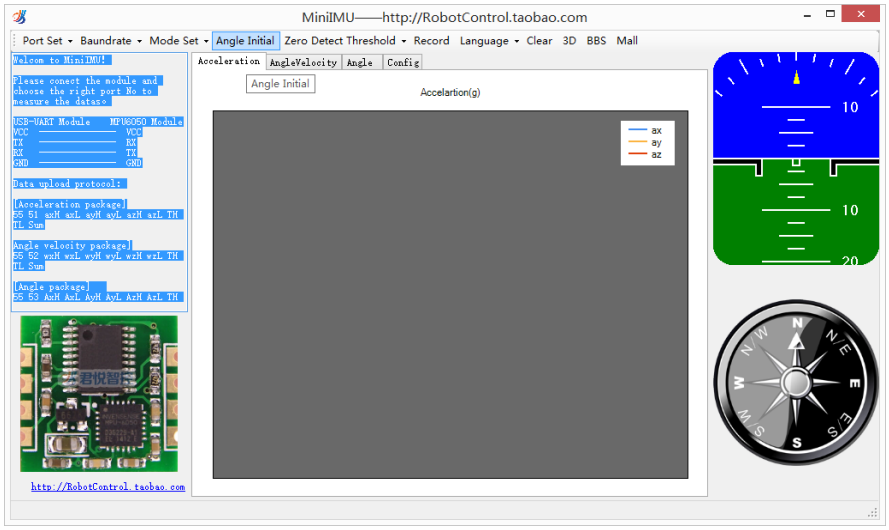




3、Switch between Serial port and IIC

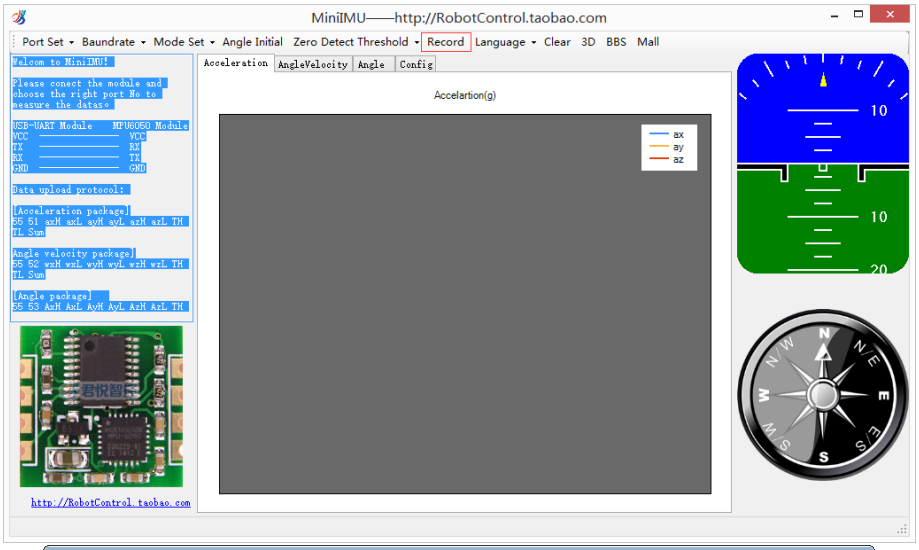


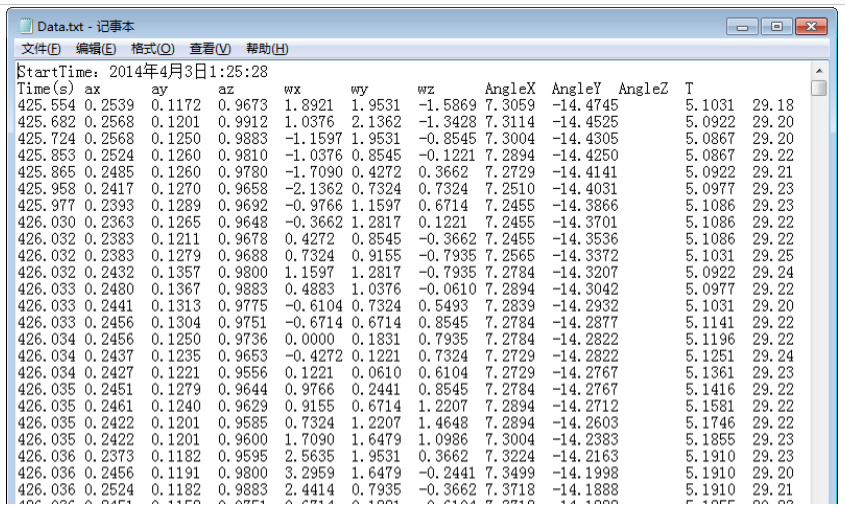
4、Angle Initial



5、Record the data

Click the record button, the software can record data to a text file, click on the record button, and when finish recording ,need to click the stop , the file will be written to the hard disk, the filepath to the root directory of the PC program of JY-61 module,the file name is the start time





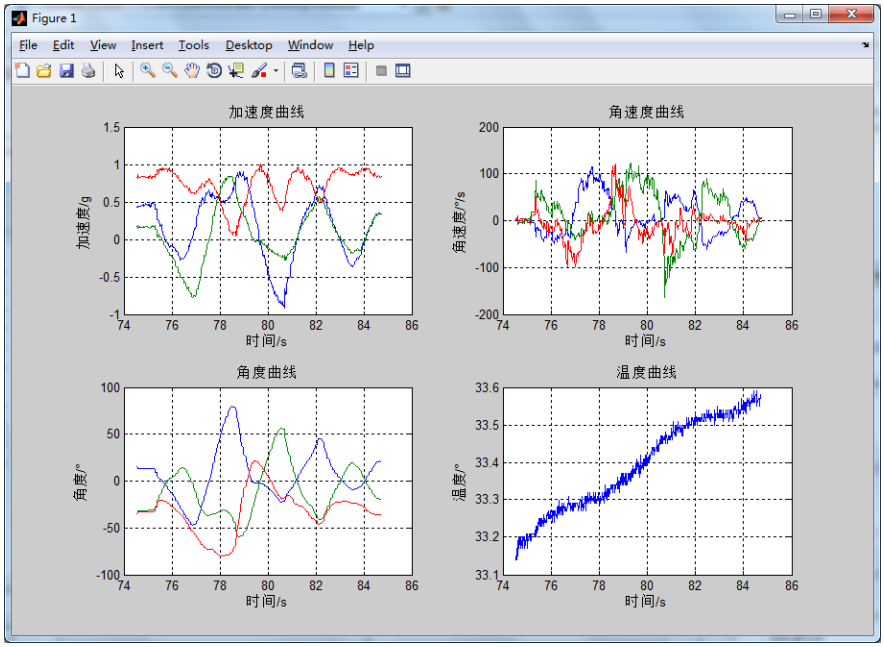
Data.txt - 记事本

文件(F) 编辑(E) 格式(O) 查看(V) 帮助(H)

StartTime：2014年4月3日1:25:28

Time(s)	ax	ay	az	wx	wy	wz	AngleX	AngleY	AngleZ	T	
425.554	0.2539	0.1172	0.9673	1.8921	1.9531	-1.5869	7.3059	-14.4745		5.1031	29.18
425.682	0.2568	0.1201	0.9912	1.0376	2.1362	-1.3428	7.3114	-14.4525		5.0922	29.20
425.724	0.2568	0.1250	0.9883	-1.1597	1.9531	-0.8545	7.3004	-14.4305		5.0867	29.20
425.853	0.2524	0.1260	0.9810	-1.0376	0.8545	-0.1221	7.2894	-14.4250		5.0867	29.22
425.865	0.2485	0.1260	0.9780	-1.7090	0.4272	0.3662	7.2729	-14.4141		5.0922	29.21
425.958	0.2417	0.1270	0.9658	-2.1362	0.7324	0.7324	7.2510	-14.4031		5.0977	29.23
425.977	0.2393	0.1289	0.9692	-0.9766	1.1597	0.6714	7.2455	-14.3866		5.1086	29.23
426.030	0.2363	0.1265	0.9648	-0.3662	1.2817	0.1221	7.2455	-14.3701		5.1086	29.22
426.032	0.2383	0.1211	0.9678	0.4272	0.8545	-0.3662	7.2455	-14.3536		5.1086	29.22
426.032	0.2383	0.1279	0.9688	0.7324	0.9155	-0.7935	7.2565	-14.3372		5.1031	29.25
426.032	0.2432	0.1357	0.9800	1.1597	1.2817	-0.7935	7.2784	-14.3207		5.0922	29.24
426.033	0.2480	0.1367	0.9883	0.4883	1.0376	-0.0610	7.2894	-14.3042		5.0977	29.22
426.033	0.2441	0.1313	0.9775	-0.6104	0.7324	0.5493	7.2839	-14.2932		5.1031	29.20
426.033	0.2456	0.1304	0.9751	-0.6714	0.6714	0.8545	7.2784	-14.2877		5.1141	29.22
426.034	0.2456	0.1250	0.9736	0.0000	0.1831	0.7935	7.2784	-14.2822		5.1196	29.22
426.034	0.2437	0.1235	0.9653	-0.4272	0.1221	0.7324	7.2729	-14.2822		5.1251	29.24
426.034	0.2427	0.1221	0.9556	0.1221	0.0610	0.6104	7.2729	-14.2767		5.1361	29.23
426.035	0.2451	0.1279	0.9644	0.9766	0.2441	0.8545	7.2784	-14.2767		5.1416	29.22
426.035	0.2461	0.1240	0.9629	0.9155	0.6714	1.2207	7.2894	-14.2712		5.1581	29.22
426.035	0.2422	0.1201	0.9585	0.7324	1.2207	1.4648	7.2894	-14.2603		5.1746	29.22
426.035	0.2422	0.1201	0.9600	1.7090	1.6479	1.0986	7.3004	-14.2383		5.1855	29.23
426.036	0.2373	0.1182	0.9595	2.5635	1.9531	0.3662	7.3224	-14.2163		5.1910	29.23
426.036	0.2456	0.1191	0.9800	3.2959	1.6479	-0.2441	7.3499	-14.1998		5.1910	29.20
426.036	0.2524	0.1182	0.9883	2.4414	0.7935	-0.3662	7.3718	-14.1888		5.1910	29.21

Data can be imported into the Exel or analysis in Matlab. In the Matlab environment running xxx.m document and it can plot of the data.



6、Language

Click on the language menu, you can switch the language between Chinese and English

7、Clear

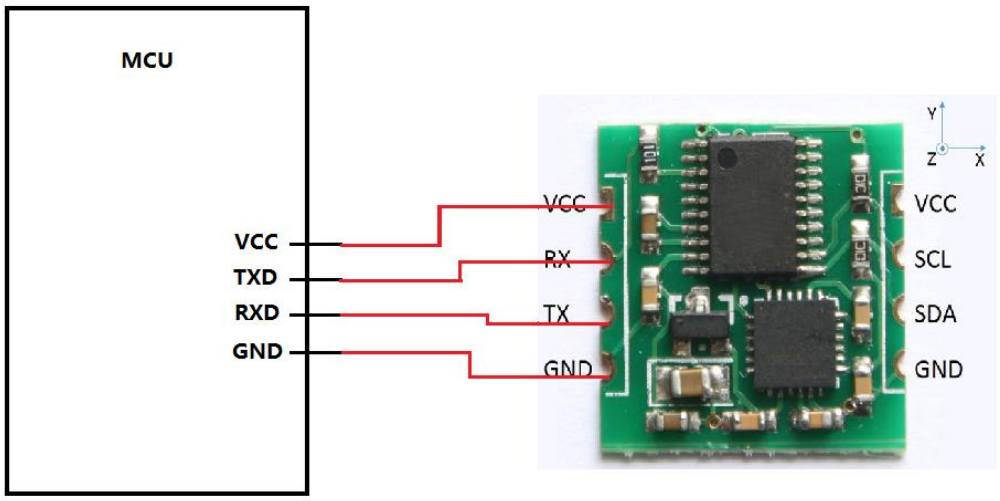
Click clear diagram button, you can clear the data displayed in the chart. When collecting this data with the previous data collection interval for a long time, the chart will update slower, then you can click on the clear button, It will become faster.

8、3D

Click the three-dimensional buttons, call up the three-dimensional display screen, displaying three-dimensional posture of the module. After starting the three-dimensional model, the default

interface is full screen, and to change back to the window mode, you can press the [F] key, if you can not switch, press ctrl + Space to change the input method to English,then press [F]key

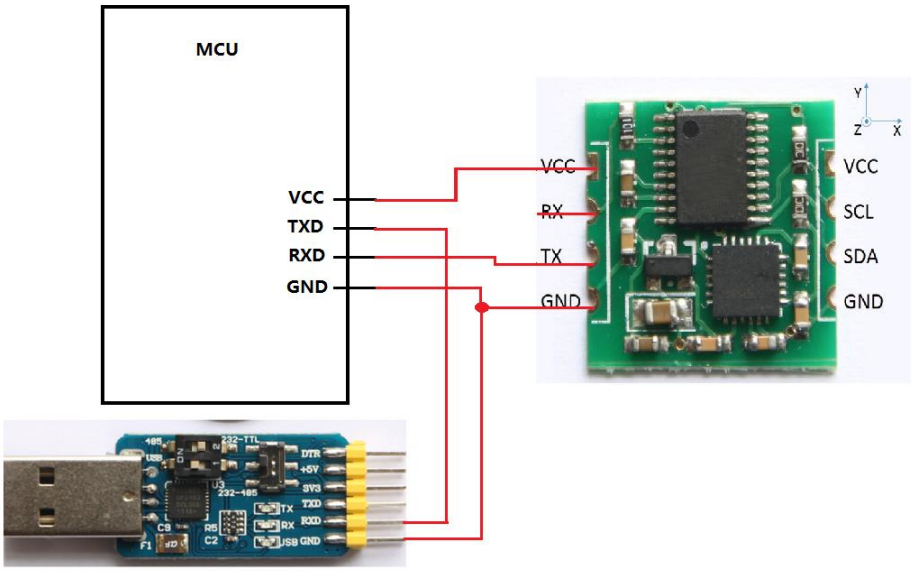
4.4 Connected to MCU



4.5 JY-61 connected to the microcontroller and output debug information

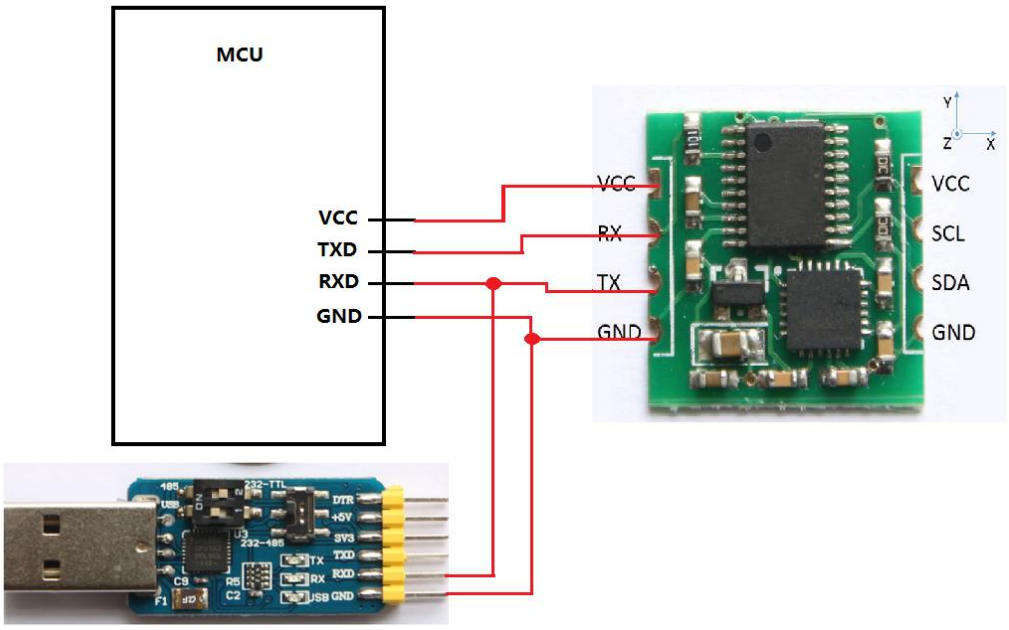
Usually, some MCU only have one serial port, the MCU will send the debug information when debugging , then you can connect the TX of MCU to the RX of the USB to the serial port

module, the TX of JY-61 connect to RX of MCU , so that MCU can receive data from the JY-61 module, and output debugging information. MCU is unable to send the serial command to the JY-61 module, but the configuration of the module can be saved when set it, then you can use it.



4.6 PC program monitoring module and MCU communication。

PC program and MCU can get the data from JY-61 module at the same time



5 Serial communication protocol

Level: TTL level (non RS232 level, if the module is wrong to the RS232 level may cause damage to the module)

Baud rate: 115200/9600, stop bit 1 and parity bit 0

5.1 PC program to Module

Note：

1. Default settings using the serial port, baud rate 115200, return rate 100Hz. configurations can be powered down save, so only configured once on the line.
2. Format

0xFF	0xAA	Command

Content	Function	Description
0xFF 0xAA 0x52	Angle initialization	Z axis angle to zero
0xFF 0xAA 0x61	Using serial port, disable I2C	Power down saved
0xFF 0xAA 0x62	Disable serial port, using I2C interface	Power down saved
0xFF 0xAA 0x63	Baud rate115200， Frame rate 100Hz	Power down saved
0xFF 0xAA 0x64	Baud rate 9600， Frame rate 20Hz	Power down saved

Note：

1.After the module is powered up, the MCU will be automatically calibrated at first to eliminate the gyro zero drift, and Z axis will be re initialized to 0.

2.The default baud rate is 115200,return rate 100Hz, Configuration can be configured by PC program, suggest to use the PC program to set the JY-61 module.

5.2 Module to PC program:

The module sends the data to the host computer into 3 data packets, acceleration packet, angular velocity packet and the angle packet, and the 3 packet are sent in sequence .

5.2.1 Acceleration output：

0x55	0x51	AxL	AxH	AyL	AyH	AzL	AzH	TL	TH	SUM

Calculate formula：

a_x=((AxH<<8)|AxL)/32768*16g(g is Gravity acceleration，9.8m/s^2)

a_y=((AyH<<8)|AyL)/32768*16g(g is Gravity acceleration，9.8m/s^2)

a_z=((AzH<<8)|AzL)/32768*16g(g is Gravity acceleration，9.8m/s^2)

Temperature calculated formular：

T=((TH<<8)|TL) /340+36.53 ℃

Checksum：

Sum=0x55+0x51+AxH+AxL+AyH+AyL+AzH+AzL+TH+TL

Note：

1、 the data is transmitted in accordance with the 16 hexadecimal, not ASCII code

2、 Each data is transmitted in a low byte and a high byte, and the two is combined into a short type of symbol. Such as X axis acceleration data Ax, where AxL is the low byte, AxH is high byte.

The conversion method is as follows:

Assuming Data is the actual data, DataH for its high byte, DataL for its low byte part, then: Data= ((short) DataH<<8) |DataL. Here we must pay attention to that force the DataH to be converted into a symbol of the short type of data and then after shift 8

bit, and the type of Data is also a symbol of the short type, so it can show a negative.

5.2.2 Angular velocity output：

0x55	0x52	wxL	wxH	wyL	wyH	wzL	wzH	TL	TH	SUM

Calculated formular：

w_x=((wxH<<8)|wxL)/32768*2000(°/s)

w_y=((wyH<<8)|wyL)/32768*2000(°/s)

w_z=((wzH<<8)|wzL)/32768*2000(°/s)

Temperature calculated formular：

T=((TH<<8)|TL) /340+36.53 ℃

Checksum：

Sum=0x55+0x52+wxH+wxL+wyH+wyL+wzH+wzL+TH+TL

5.2.3 Angle Output：

0x55	0x53	RollL	RollH	PitchL	PitchH	YawL	YawH	TL	TH	SUM

Calculated formular：

Roll（x axis）Roll=((RollH<<8)|RollL)/32768*180(°)

Pitch（y axis）Pitch=((PitchH<<8)|PitchL)/32768*180(°)

Yaw（z axis）Yaw=((YawH<<8)|YawL)/32768*180(°)

Temperature calculated formular：

T=((TH<<8)|TL) /340+36.53 ℃

Checksum：

Sum=0x55+0x53+RollH+RollL+PitchH+PitchL+YawH+YawL+TH+TL

Note：

1. Attitude angle use the coordinate system for the Northeast sky coordinate system, the X axis is East,the Y axis is North, Z axis toward sky. Euler coordinate system rotation sequence defined attitude is z-y-x, first rotates around the Z axis. Then, around the Y axis, and then around the X axis.
2. In fact, the rotation sequence is Z-Y-X, the range of pitch angle (Y axis) is only ±90 degrees, when the pitch angle (Y axis) is bigger than 90 degrees and the pitch angle (Y axis) will become less than 90 degrees. At the same time, the Roll Angle(X axis) will become larger than 180 degree. Please search on Google about more information of Euler angle and attitude information.
1. Since the three axis are coupled, the angle will be independent only when the angle is small. It will be dependent of the three angle when the angle is large when the attitude angle change, such as when the X axis close to 90 degrees, even if the attitude angle around the X axis, Y axis angle will have a big change, which is the inherent characteristics of the Euler angle

5.2.4 IIC mode ：

0x55	0x50	0x00	0x01	0x00	0x02	0x00	0x03	0x00	0x04	SUM

The data packet is used to indicate the module whether enter into the IIC mode, the module will release the IIC MPU6050 bus, and the user can access to the original data of the MPU6050 chip by IIC. If you receive 0x55 0x50 at the beginning of the data packet, the module works in the IIC mode, when you want to switch to the serial mode, please send a command 0xFF 0xAA 0x61, or use the PC program to modify.

5.3 Data analysis sample code(Language C)：

```
double a[3],w[3],Angle[3],T;
void DecodeIMUData(unsigned char chrTemp[])
{
	switch(chrTemp[1])
	{
	case 0x51:
		a[0] = ((short)(chrTemp[3]<<8|chrTemp[2]))/32768.0*16;
		a[1] = ((short) (chrTemp[5]<<8|chrTemp[4]))/32768.0*16;
		a[2] = ((short) (chrTemp[7]<<8|chrTemp[6]))/32768.0*16;
		T = ((short) (chrTemp[9]<<8|chrTemp[8]))/340.0+36.25;
		break;
	case 0x52:
		w[0] = ((short) (chrTemp[3]<<8|chrTemp[2]))/32768.0*2000;
		w[1] = ((short) (chrTemp[5]<<8|chrTemp[4]))/32768.0*2000;
		w[2] = ((short) (chrTemp[7]<<8|chrTemp[6]))/32768.0*2000;
		T = ((short) (chrTemp[9]<<8|chrTemp[8]))/340.0+36.25;
		break;
	case 0x53:
		Angle[0] = ((short) (chrTemp[3]<<8|chrTemp[2]))/32768.0*180;
		Angle[1] = ((short) (chrTemp[5]<<8|chrTemp[4]))/32768.0*180;
		Angle[2] = ((short)(chrTemp[7]<<8|chrTemp[6]))/32768.0*180;
		T = ((short)(chrTemp[9]<<8|chrTemp[8]))/340.0+36.25;
		printf("a = %4.3f\t%4.3f\t%4.3f\t\r\n",a[0],a[1],a[2]);
		printf("w = %4.3f\t%4.3f\t%4.3f\t\r\n",w[0],w[1],w[2]);
		printf("Angle = %4.2f\t%4.2f\t%4.2f\tT=%4.2f\r\n",Angle[0],Angle[1],Angle[2],T);
		break;
	}
}
```

5.4 Examples of analytical data in embedded environment

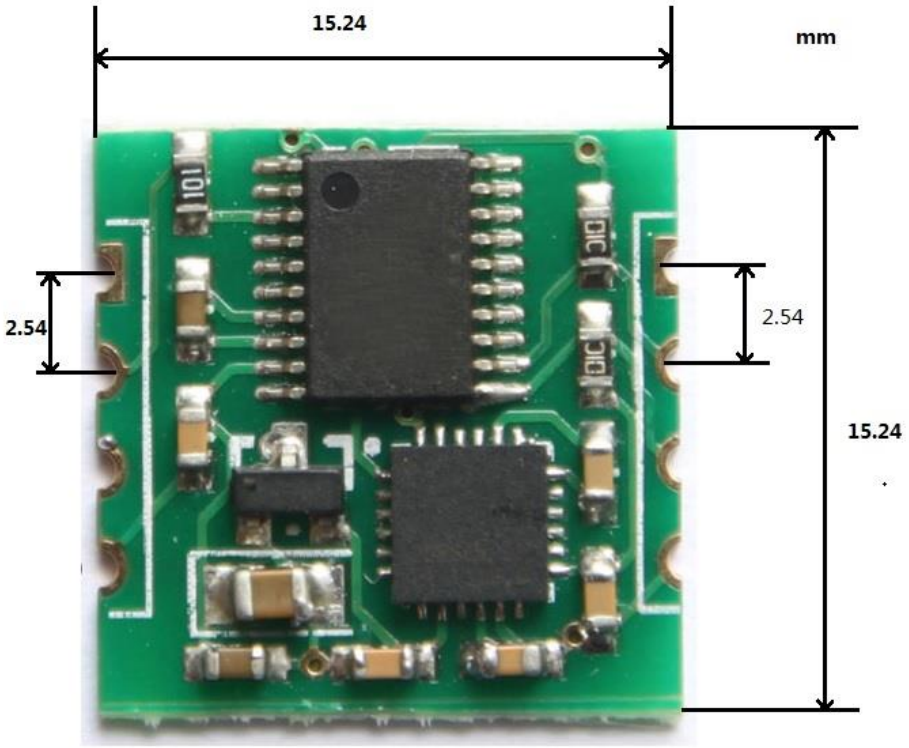
The code is divided into two parts, one is in interrupt to receive, to find the data's head, and then put the packet into the array. The other is data analysis in the main code.

Interrupt part(The following is the AVR microcontroller code. The other microcontroller will be a little difference)

```
unsigned char Re_buf[11],counter=0;
unsigned char sign;
interrupt [USART_RXC] void usart_rx_isr(void) //USART receive
 {
	Re_buf[counter]=UDR;// Slight difference between different microcontroller
	if(counter==0&&Re_buf[0]!=0x55) return;		// if the first data is not frame header, skip
	counter++;
	if(counter==11) // Receive 11 data
	{
	    counter=0; // Re assignment, prepare for the next frame of data receiving
	    sign=1;
	}
 }
```

Main code：

```
float a[3],w[3],angle[3],T;
extern unsigned char Re_buf[11],counter;
extern unsigned char sign;
```

```
while(1)
{
    if(sign)
    {
        sign=0;
        if(Re_buf[0]==0x55)          //check the head
        {
            switch(Re_buf [1])
            {
            case 0x51:
                a[0] = (short(Re_buf [3]<<8| Re_buf [2]))/32768.0*16;
                a[1] = (short(Re_buf [5]<<8| Re_buf [4]))/32768.0*16;
                a[2] = (short(Re_buf [7]<<8| Re_buf [6]))/32768.0*16;
                T = (short(Re_buf [9]<<8| Re_buf [8]))/340.0+36.25;
                break;
            case 0x52:
                w[0] = (short(Re_buf [3]<<8| Re_buf [2]))/32768.0*2000;
                w[1] = (short(Re_buf [5]<<8| Re_buf [4]))/32768.0*2000;
                w[2] = (short(Re_buf [7]<<8| Re_buf [6]))/32768.0*2000;
                T = (short(Re_buf [9]<<8| Re_buf [8]))/340.0+36.25;
                break;
            case 0x53:
                angle[0] = (short(Re_buf [3]<<8| Re_buf [2]))/32768.0*180;
                angle[1] = (short(Re_buf [5]<<8| Re_buf [4]))/32768.0*180;
                angle[2] = (short(Re_buf [7]<<8| Re_buf [6]))/32768.0*180;
                T = (short(Re_buf [9]<<8| Re_buf [8]))/340.0+36.25;
                break;
            }
        }
    }
```

6 Size